Lab 9.1 Camera Calibration

In this lab you will try calibrating a camera in two different ways and compare the results.

You will need some kind of digital camera to work with -- for example your laptop camera or a smartphone camera. If you don't have access to a suitable camera (or even if you do), it is okay to find someone in the class who does and work as a group.

Follow the instructions below and prepare and submit a document answering the questions in this lab.

1. Look at some images or the live feed from your camera. Without making any measurements, what would you guess is the field-of-view of your camera (along the larger dimension)?
2. You can use the method of similar triangles to estimate the focal length of your camera (and from the focal length, the field-of-view). If you know a) the size of an object, b) the distance to the object, and c) the apparent size of the object in the image, then you can calculate the focal length.

- Write down the formula for calculating the focal length in this manner. Then make measurements of some object (for example, a piece of paper, or a pencil) to estimate the focal length.
- Convert the focal length to field-of-view using the formula presented in class. You will need to know the height and width of the camera image in pixels.

3. Take images of a checkerboard calibration pattern with your camera. It works well to show the checkerboard on your laptop screen and take photos with your phone, or vice versa. Hold the checkerboard at different angles and positions and take at least 12 images.

- Use the provided notebook to run OpenCV's camera calibration functionality and estimate the intrinsics parameters of your camera. (You can install OpenCV locally with `pip install opencv-python` or run the notebook in Google Colab which has OpenCV pre-installed.)
- Calculate the field-of-view according to OpenCV's estimate of the focal length.
- Compare the results from the checkerboard calibration with your initial guess in step 1 and your manual procedure in step 2.